GRIPS Discussion Paper 20-10

Incomplete Information Sharing within the Household: Evidence from Participation in Agricultural Training in Zambia

By

Ken Miura
Yoko Kijima
Takeshi Sakurai

September 2020

National Graduate Institute for Policy Studies
7-22-1 Roppongi, Minato-ku,
Tokyo, Japan 106-8677

Incomplete Information Sharing within the Household:

Evidence from Participation in Agricultural Training in Zambia

Ken Miura[1]*, **Yoko Kijima**[2] **and Takeshi Sakurai**[3]

September 2020

This study estimates the impact of the gender of informed individuals on agricultural training participation. To do so, we randomly distributed information about a rice planting demonstration to husbands or wives in rural Zambia. The results show that information recipients were much more likely to join the training than the non-recipients from the same household, indicating that information does not flow well among spouses. We present evidence that information sharing is distorted by intra-household differences in management rights over productive lands for rice cultivation.

Key words: knowledge diffusion, intra-household bargaining, sub-Saharan Africa

[1] Kyoto University
[2] National Graduate Institute for Policy Studies (GRIPS)
[3] The University of Tokyo
*Corresponding author: miura.ken.3e@kyoto-u.ac.jp

1. Introduction

The low adoption of profitable agricultural technologies and techniques is common in rural areas in Africa. The extant literature identifies a lack of knowledge about a technology's existence, use, and benefits as one of prevailing barriers to its usage (Magruder 2018). Reflecting this view, current policy debates revolve around how to effectively spread relevant and accurate information on technology among farmers. The traditional approach to transmitting information leverages the existing social networks of farm households. In practice, agricultural programs generally target household heads, who are usually male farmers, partly reflected by the view that the females in male-headed households have little power to make decisions. In addition, the fact that the public extension agents are predominantly males may put females further at a disadvantage (Kondylis et al. 2016). This indicates that female farmers would have limited opportunities to acquire knowledge about recommended agricultural practices in the current extension system (BenYishay et al. 2020).

However, African women devote the same time with their husbands to farming activities. Furthermore, they often have an independent authority to manage plots and make agricultural decisions, reflecting local cultural practices. If female farmers' participation in opportunities to learn profitable techniques is restricted by information barriers under the conventional male-dominated program, the direct information delivery to women would have productivity consequences and implications for African agriculture.

This study assesses the importance of intra-household sharing of information about agricultural training in actual participation. Theoretical predictions depend on how we model households. According to the unitary model, the identity of information recipients should not matter, since all the decision-relevant information translates to common knowledge within marriage. As a result, the best member who benefits from the training will appear. In practice, however, each family member with different preferences and

resource constraints is involved in the household decision-making process. The model with the nature of collective decision suggests the possibility of incomplete information sharing within the household because the information useful for one of the spouses would not be so for the other. Rather, passing information to the spouse may backfire in the future if he/she increases their productivity through training, thereby improving their bargaining position in the household.

This study tests this possibility with data from the rural parts of Zambia, where many suitable lands for rice production are left unexploited. To quantify the actual demand for rice cultivation, we conducted a demand experiment on upland rice seeds for production in October 2018 (Miura, Kijima and Sakurai 2020). In fact, rice seed demand was found to be low among the sampled farmers with little prior experience in its cultivation. In addition, many purchase households did not plant rice seeds during the 2018/19 crop season. According to the farmers, their main reason was a lack of managerial know-how about rice cultivation. To solve their information constraints, we offered simple training sessions on rice planting in November 2019. In doing so, we randomized the gender of the recipient who is informed about the training that is open for everyone in the village to measure the extent of information sharing within the household. We divided the sample into three groups: a group of households in which the wife receives the information about the training, a group of households in which the husband receives the information, and a control group of households in which no information was given. We exploit this experimental variation to estimate the impact of who receives the information within the household on the likelihood of training participation.

Results show evidence of incomplete information sharing among spouses. Our intention-to-treat estimates show that information recipients are more likely to come to join the training irrespective of purchase history and their gender, even though the letter clearly mentions that his/her spouse also can join the event. Intra-household information spillovers were detected among purchase households only when

the information was given to the wife who manages plots suitable for rice. In that case, some husbands joined the training session. Such spillovers were not observed for non-purchase households.

This study is one of the first to investigate the possibility of incomplete information flow within households. While the literature underlines the salience of peers as a credible source of information, previous studies rarely addressed the role of spouses. Magnan et al. (2015) is a notable complementary study; they described existing intra-household differences in network links and estimated their differentiated effects on demand for a water management technique. Conversely, our study focuses on spousal differences in management rights over lands as an impediment to information circulation within the household.

The remainder of this paper is organized as follows. Section 2 describes the setting and our experimental design. While Section 3 provides the main results, Section 4 explores the mechanism behind the key finding. Section 5 concludes.

2. Context and Experimental Design

1) Experimental Context

Our survey area is in the Masaiti District of Copperbelt Province, Zambia. People's livelihoods depend mainly on rain-fed agriculture, and the major crops for cultivation are maize, cassava, rape and groundnuts. This district features shallow wetlands, which are inundated during the rainy season and become arid by the end of the dry season but retain some moisture through the season, locally referred to as dambo. Field observations found that many dambo lands were left unexploited. The main reason for this low utilization is that maize is not the best crop to plant on dambo, and no alternative crops are suitable for growing during the rainy season. Taking advantage of the remaining moisture in their soils, only a few farmers grow vegetables on dambo during the dry season. Hence, making full use of unexploited dambo fields

could create alternative income sources.

Candidates include rice, such as New Rice for Africa (NERICA) variety, which is suitable for the African environment. The dissemination of rice cultivation will benefit people's livelihoods in many ways since rice will provide them with a new cash-earning opportunity and contribute to their diet. However, rice seeds for production were not available in the local markets. Therefore, we introduced NERICA rice seeds (NERICA 4) to local farmers with little prior experience in its cultivation in 2018.

To conduct a demand experiment involving NERICA, we randomly selected 40 villages among the 60 villages in which a community survey had been conducted before. From each village, we randomly selected approximately 60% of the households to form our sample. Our survey team collected baseline information from 621 households in July and August 2018. Among them, 532 households were invited to rice sales meetings in October 2018. A total of 155 households (about 30%) purchased rice seeds, and the average purchase amount conditional on take-up was 2.6 kilograms. We then observed that only 34 purchase households planted rice in the 2018/19 agricultural season. According to the sampled farmers, the main reason was a lack of working knowledge about its cultivation.[1)] We provided 621 original households another chance to buy seeds in June 2019, but only 51 households purchased it partly because interested farmers still kept rice seeds from the last purchase.

2) Experiments

To alleviate informational deficiencies, we offered 1-hour training sessions by enumerators and camp extension officers in November 2019. Therefore, we selected 17 demonstration sites for every 3 to 4 villages in August 2019. The session demonstrated rice planting and explained basic information about weeding and harvesting. Approximately 2 weeks before scheduled training dates, we informed the sampled households of the event with the letter describing when and where the training would be

1) At the baseline survey, basic information on rice cultivation was explained with a brochure to all the interviewed farmers.

happening. The letter also described that any household member could join the event.

To investigate the extent to which information flows within the household, we randomly changed how the letter was delivered. Our experimental sample comprised 621 original households.[2] The design began with stratification based on purchase history. Among 190 households that have purchased rice seeds from us at least once, 156 households belonged to married couples.[3] For these households, we attempted to deliver the letter to the wife for randomly selected 79 households (TW_P) and to the husband for the remaining 77 households (TH_P). Among the 431 non-purchase households, 303 households belonged to couples. We randomly divided them equally into (1) a treatment group of households in which the wife received the letter (TW_NP), (2) a treatment group of households in which the husband received it (TH_NP), or (3) a control group of households that received no information (C_NP).

Our enumerators have tried to deliver the letter to the assigned recipients as much as they can for the last 2 weeks of October 2019, although we allowed them to leave it with their spouses and neighbors if they were not available. The overall compliance rate was 67.0%. Given this imperfect compliance with the treatment, we will focus on intention-to-treat (ITT) estimates in the regression analysis.[4]

As baseline characteristics, we used information from the baseline survey conducted in July and August 2018. The survey questionnaire consisted of two sections. The first part collected household-level information, such as demographics and asset ownership. The second part of interviews about individual-specific information was conducted separately with household heads and their spouses in turn in isolation from others. At the end of the interview, they were separately asked whether one would like to buy rice seeds at a given price and if so how many kilograms would be purchased.

2) Although a few households had already been shifted before our intervention in 2019, we just maintained initial households to get around the non-random assignment of treatment.
3) The remaining 34 were single households and so we did not use them for the analysis in this paper.
4) Out of our 358 treatment households, the letter was given to the spouse for 31 households, to other family members for 35 households, and to neighbors for 40 households. 12 households were absent because of migration. If such non-compliers are systematically different in unobservable ways, then the local average treatment estimates will not be a consistent estimator of the average treatment effect.

This study focuses on 442 married couples with complete information as our analysis sample. Table 1 shows the balance of observable houeshold and spousal characteristics across the treatment arms for the purchase households. Statistically significant differences were detected at the 5% level for three out of the 19 variables examined here. Randomization was done by computer, and these just emerged by chance. Nevertheless, we control for these covariates in the regression to assure the orthogonality of the treatment assignments. Table 2 reports the same baseline characteristics for the non-purchase households, indicating that the randomization created fairly comparable groups.

3. Estimation Models and Results

1) Empirical specifications

We estimate the impact of the gender of information receivers on participation in the training separately for non-purchase and purchase households, since we did not set the control group for the latter. To examine the determinants of training participation for non-purchase households, we run the following regression equation by OLS:

$$y_i = \beta_W TW_i + \beta_H TH_i + X_i^h \gamma_h + X_i^H \gamma_H + X_i^W \gamma_W + \varepsilon_i$$

where y_i is either an indicator variable for participation of wife from household *i* or an indicator variable for participation of husband from household *i*, *TW* (*TH*) takes 1 if a married wife (husband) of household *i* is assigned to receive the letter and zero otherwise, and ε_i is an error term. Because the randomized distribution of the letters ensures that the treatment indicators (*TW* and *TH*) and ε_i are orthogonal in theory, the OLS estimates will provide an unbiased estimator for the ITT effects. In this specification, the ITT effect of the letter given to wife (husband) is captured by β_W (β_H). We test whether $\beta_W = \beta_H$ holds to evaluate the extent of information sharing within the household, since the likelihood of participation by, say, wife should not be affected by who received the letter under the assumption of complete

information sharing among spouses.

X_i^h is a set of baseline household characteristics that may predict the likelihood of participation in training. These covariates include household size, total area of land owned, total value of household assets such as livestock and durables, and the indicator variable for previous experience in rice cultivation before 2018. As the survey villages were spread across five agricultural extension camps, we included camp fixed effects. X_i^H is a set of baseline characteristics of the husband from household *i*, while X_i^W is the exact same set of controls but for the wife from household *i*. Spousal characteristics used for the analysis are presented in Table 2.

Since randomization was done at the household level, one concern is information spillover to the control group that would contaminate the true treatment effects. To deal with this empirical concern, we exploit randomly-determined treatment intensities per village by controlling for the number of other treatment households in the same village in all the regressions.[5)]

For the purchase households, we specify the model as

$$y_i = \beta_W TW_i + X_i^h \gamma_h + X_i^H \gamma_H + X_i^W \gamma_W + \varepsilon_i$$

In this specification, β_W measures the relative propensity to participate in the training session when the wife receives the letter compared to when the husband does so.

2) Results

Figure 1 reports participation rates across treatment statuses. There are three main findings. First, information recipients are more likely to join the training than non-recipients, irrespective of purchase

5) In fact, possible spillover effects from treatment to control households turn out not to be a great concern in this context for the following two reasons. First, as will be seen in Figure 1, participation rates are negligible for the control group. Second, the coefficients on the number of the other treatment households in the same village are never significant across all the regressions. However, we observed that 44 participants were from non-survey households, indicating the presence of information spillovers from our treatment households to non-survey households that were interested in rice cultivation.

history and gender of participants. Second, we found evidence of intra-household information spillovers on the recipient's spouses for some purchase households. In particular, 19% of husbands also took part in the training when their wives were informed. While there were 17 households from which both spouses showed up at the demonstration site, 11 households were from the category TW_P. Finally, control households rarely joined the training session, suggesting that the information about the training did not flow from the treatment households.

These basic patterns are also confirmed even after controlling for household and spousal baseline characteristics. Regression results for purchase households are reported in columns (1) and (2) of Table 3. Results show that wives are more likely to take part in the training by 31 percentage points when they are assigned to receive the letter than when their husbands are targeted. While the magnitude is not so large due to intra-household information spillovers from the informed spouse to the other, the difference in the likelihood of husbands' participation between the two treatment groups is also statistically significant (column 2). Finally, the equality between the coefficients on TW and TH was strongly rejected for non-purchase households (columns 3 and 4). These results would not be observed if information were shared well within the household. Overall, we found evidence that to whom information about training was targeted results in different impacts on participation rates.

4. Heterogeneity by dambo management

This section explores the mechanism behind the empirical pattern of sample farmers' participation in training. The observed incomplete information sharing suggests the possibility of strategic information withholding by information recipients. What is the conflict of interest among spouses? We also found evidence of intra-household information sharing for some purchase households. What is the condition for information sharing to happen within the household?

Our companion paper highlights the importance of the identity of dambo managers in explaining household demand for rice seeds (Miura, Kijima and Sakurai 2020). In the survey area, management rights over plots are individualized, and a good number of wives also have the authority to choose which crop to grow for agricultural fields. The intra-household allocations of management rights over plots are determined and fixed at marriage. Miura, Kijima, and Sakurai (2020) show that the impact of who received monetary incentives in the form of transportation voucher between villages and a miller on rice seed take-up depends on who controls dambo plots within the household. More precisely, voucher recipients did not fully take advantage of it for fear of increasing the bargaining position of their spouses who manage suitable lands for rice production (i.e., dambo). The same logic can be applied to our empirical context. If the information recipient does not have any control over the dambo, they would not take part in the training. Rather, they may have an incentive to conceal the relevant information from the spouse.

This possibility is explored by including the interaction terms between our treatment and the gender of the dambo plot manager. Table 4 presents the estimation results. For the purchase households in columns (1) – (3), the reference category is TH households that do not own any dambo fields. We find that when wives receive the letter, their likelihood of participation is relatively high regardless of dambo management patterns. On the contrary, the pattern of husbands' participation differs with the gender of dambo managers (column 2). Since intra-household allocation of management rights over dambo would be endogenous to participation behavior, we compare the results within households in which the husband/wife manages dambo. When the husband manages dambo, the impact of the letter to wives is smaller by 28 (-0.073-0.202) percentage points than the impact of the letter to husbands. Since this difference was statistically significant at the 10% level, the information is less likely to share from the wife to the husband in such households. If the wife chooses what to cultivate on dambo, husbands were

more likely to attend the training session by 27 (-0.073+0.339) percentage points when the wife was informed than when the husband was informed. The difference was also statistically significant at the 10% level. Thus, the observed information spillovers from the wife to the husband were happening for such households. As a result, the fraction of households in which no family member joined the training was the highest when the husband received information about the training and the wife managed productive plots for rice cultivation (column 3). In such households, information sharing among spouses was particularly distorted. This differential impact by the gender of information recipients can also be seen for non-purchase households in which the wife controls dambo (-0.142+0.018 vs. -0.138-0.303 in column 6).

5. Conclusion

Although African women often have an individual right to make agricultural decisions, they may have limited access to decision-relevant information and managerial know-how under the current extension system. This study presents evidence that information does not flow well within the household. While the existing practice for most agricultural extension programs is to target household heads (and hence typically males), our findings suggest that direct targeting may be required to ensure that individuals who need information actually receive it.

Acknowledgement

We thank two referees for helpful comments. This study was financially supported by JSPS KAKENHI No. 16H02733.

References

BenYishay, A., M. Jones, F. Kondylis, and A.M. Mobarak (2020) Gender Gaps in Technology Diffusion. *Journal of Development Economics,* 143: 102380.

Kondylis, F., V. Mueller, G. Sheriff, and S. Zhu (2016) Do Female Instructors Reduce Gender Bias in Diffusion of Sustainable Land Management Techniques? Experimental Evidence from Mozambique. *World Development*, 78: 436-449.

Magnan, N., D. Spielman, K. Gulati, and T. Lybbert (2015) Information Networks among Women and Men and the Demand for an Agricultural Technology in India. IFPRI Discussion Paper No. 1411.

Magruder, J. R. (2018) An Assessment of Experimental Evidence on Agricultural Technology Adoption in Developing Countries. *Annual Review of Resource Economics*, 10: 299-316.

Miura, K., Y. Kijima, and T. Sakurai (2020) Intrahousehold Bargaining and Agricultural Technology Adoption: Experimental Evidence from Zambia. GRIPS Discussion Paper. No. 20-01.

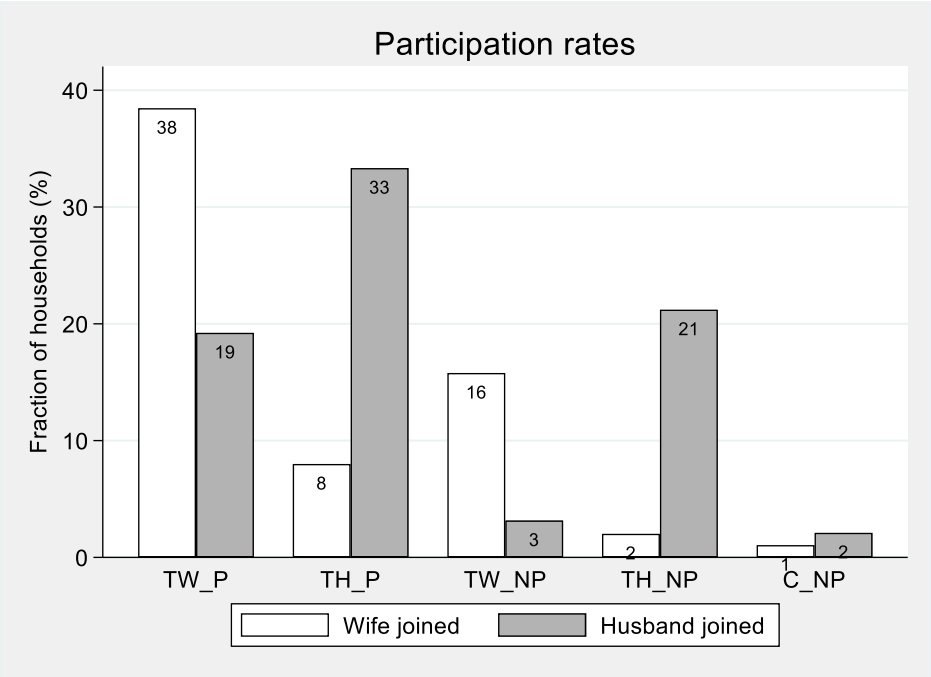

Figure 1. Participation rates by treatment status

Table 1. Balance test for purchase households

	(1) TW_P	(2) TH_P	t-test p-value
Variable	Mean/SD	Mean/SD	(1)-(2)
# of other treatment HHs in the same village	16.13	15.77	0.82
	[10.49]	[8.91]	
family size	6.37	6.67	0.43
	[2.46]	[2.09]	
land size (ha)	3.86	3.28	0.30
	[3.64]	[3.26]	
value of assets (K1000)	5.41	4.80	0.54
	[6.45]	[6.16]	
=1 if grown rice in last 10 years	0.08	0.09	0.72
	[0.27]	[0.29]	
age, wife	44.00	38.96	0.01***
	[12.20]	[11.24]	
age, husb	51.08	45.69	0.01**
	[13.65]	[12.48]	
years of education, wife	6.00	6.43	0.34
	[2.63]	[2.84]	
years of education, husb	7.42	7.37	0.91
	[2.82]	[2.88]	
non-farm income (K1000/year), wife	0.65	0.58	0.87
	[3.73]	[1.63]	
non-farm income (K1000/year), husb	2.90	1.68	0.05**
	[4.55]	[2.81]	
risk preference, wife	0.71	0.70	0.76
	[0.21]	[0.27]	
risk preference, husb	0.68	0.73	0.20
	[0.27]	[0.20]	
financial autonomy (K100), wife	0.62	0.68	0.67
	[0.78]	[0.97]	
financial autonomy (K100), husb	0.74	0.99	0.13
	[0.80]	[1.13]	
pre-demand in kg, wife	4.81	3.92	0.07*
	[3.25]	[2.76]	
pre-demand in kg, husb	5.24	4.76	0.33
	[3.10]	[3.07]	
=1 if wife manages dambo	0.13	0.08	0.33
	[0.34]	[0.27]	
=1 if husband manages dambo	0.40	0.43	0.72
	[0.49]	[0.50]	
N	78	75	

Notes: HH (husb) stands for household (husband). Entries in the last column are p-values from the t-test for equality across treatment status. The index for financial autonomy was created based on the following question: "How much can you spend at one time without consulting your spouse?" The options are "less than K10," "K10-K30," "K30-K50," "K50-K100," "K100-K300," "K300-K500," and "more than K500." We use the intermediate value for each option as a proxy for financial autonomy. Risk preference parameters are elicited from a Binswanger-style hypothetical game. A higher value indicates more risk averse.

Table 2. Balance test for non-purchase households

Variable	(1) TW_NP Mean/SD	(2) TH_NP Mean/SD	(3) C_NP Mean/SD	F-test for joint orthogonality
# of other treatment HHs in the same village	15.06	15.68	16.49	0.66
	[10.03]	[10.85]	[11.61]	
family size	5.43	5.29	5.49	0.76
	[1.92]	[1.80]	[2.07]	
land size (ha)	2.80	2.23	3.13	0.14
	[3.55]	[2.10]	[3.71]	
value of assets (K1000)	3.22	2.43	2.97	0.63
	[8.85]	[2.40]	[4.42]	
=1 if grown rice in last 10 years	0.06	0.08	0.06	0.86
	[0.24]	[0.27]	[0.24]	
age, wife	37.45	38.40	38.86	0.75
	[12.85]	[13.45]	[13.14]	
age, husb	43.02	43.83	44.44	0.79
	[13.92]	[14.41]	[14.75]	
years of education, wife	6.05	6.03	5.58	0.45
	[3.03]	[2.89]	[2.86]	
years of education, husb	7.11	7.53	6.97	0.42
	[3.31]	[2.96]	[2.97]	
non-farm income (K1000/year), wife	0.33	0.32	0.28	0.96
	[1.20]	[1.55]	[1.17]	
non-farm income (K1000/year), husb	2.21	2.54	2.34	0.87
	[3.77]	[4.28]	[5.01]	
risk preference, wife	0.73	0.68	0.73	0.38
	[0.26]	[0.30]	[0.26]	
risk preference, husb	0.71	0.73	0.73	0.79
	[0.28]	[0.26]	[0.25]	
financial autonomy (K100), wife	0.75	0.71	0.67	0.85
	[0.90]	[0.99]	[0.81]	
financial autonomy (K100), husb	0.66	0.72	0.71	0.84
	[0.87]	[0.72]	[0.70]	
pre-demand in kg, wife	3.66	4.23	4.57	0.09*
	[2.61]	[2.84]	[3.10]	
pre-demand in kg, husb	4.43	4.38	4.69	0.74
	[2.75]	[2.97]	[3.23]	
=1 if wife manages dambo	0.08	0.07	0.11	0.69
	[0.28]	[0.26]	[0.31]	
=1 if husband manages dambo	0.22	0.30	0.26	0.43
	[0.42]	[0.46]	[0.44]	
N	95	99	95	

Notes: HH (husb) stands for household (husband). Entries in the last column are p-values from the F-test for equality across treatment status.

Table 3. ITT estimates for the determinants of participation

	(1) wife joined	(2) husb joined	(3) wife joined	(4) husb joined
TW	0.314***	-0.127*	0.140***	0.018
	(0.068)	(0.073)	(0.038)	(0.027)
TH			-0.002	0.186***
			(0.021)	(0.045)
TW=TH (p-value)	.	.	0.00	0.00
Sample	Purchase HH	Purchase HH	Non-purchase HH	Non-purchase HH
Ref. category's mean of dep. var.	0.08	0.33	0.01	0.01
Adjusted R squared	0.14	0.09	0.10	0.11
N	153	153	289	289

Notes: Robust standard errors are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. Variables presented in Table 1 and camp fixed effects are included but not reported.

Table 4. ITT impacts by dambo management

	(1) wife joined	(2) husb joined	(3) no one joined	(4) wife joined	(5) husb joined	(6) no one joined
TW=1	0.242**	-0.073	-0.047	0.124***	0.028	-0.142***
	(0.111)	(0.103)	(0.129)	(0.040)	(0.033)	(0.048)
TW=1 # wife manages dambo=1	0.188	0.339*	-0.437**	-0.030	-0.003	0.018
	(0.206)	(0.181)	(0.213)	(0.099)	(0.066)	(0.111)
TW=1 # husband manages dambo=1	0.124	-0.202	0.021	0.084	-0.051	-0.083
	(0.150)	(0.152)	(0.181)	(0.103)	(0.053)	(0.106)
TH=1				0.002	0.150***	-0.138**
				(0.025)	(0.055)	(0.057)
TH=1 # wife manages dambo=1				0.002	0.274	-0.303
				(0.047)	(0.198)	(0.201)
TH=1 # husband manages dambo=1				-0.008	0.043	-0.093
				(0.060)	(0.096)	(0.102)
wife manages dambo=1	-0.131	-0.295***	0.422***	-0.003	-0.030	0.031
	(0.112)	(0.106)	(0.123)	(0.029)	(0.053)	(0.064)
husband manages dambo=1	-0.037	0.175	-0.099	0.017	-0.001	0.024
	(0.092)	(0.112)	(0.121)	(0.044)	(0.049)	(0.056)
Sample	purchase HH	purchase HH	purchase HH	non-purchase HH	non-purchase HH	non-purchase HH
Adjusted R squared	0.13	0.11	0.08	0.10	0.11	0.13
N	153	153	153	289	289	289